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PATENT SPECIFICATION 654,214

Date of filing Complete Specification (under Section 16 of the Patents and Designs Acts, 1907 to 1946) : Nov. 3, 1949.

Application Date : Nov. 3, 1948. No. 28586/48.

Application Date : Jan. 26, 1949. No. 2180/49.

Complete Specification Published : June 13, 1951.

Index at Acceptance :—Class 83(iv), R10, V10.

PROVISIONAL SPECIFICATION.
No. 28586, A.D. 1948.

Improvements in or relating to Pressure Welding Apparatus.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, and ANTHONY BAGNOLD SOWTER, of Research Laboratories of The General Electric Company Limited, Wembley, Middlesex, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to pressure welding apparatus.

In connection with fluid-filled, for example oil-filled electric cables, it is well known that means should be provided for compensating for expansion and contraction of the oil-filling caused by changes in temperature and barometric pressure. For this purpose, flexible and expansible gas-filled containers are used and one known form of gas-filled cell comprises two circular sheet metal discs hermetically sealed together by brazing or soldering around their meeting edges. To make such cells, a filling tube must be used and, after filling with gas such as air to the correct pressure, this tube is sealed off.

This process is somewhat lengthy and unsatisfactory in that leaks may easily develop and one object of the present invention is the provision of a pressure welding apparatus by which such gas-filled cells can be made in a simple and convenient manner.

According to the present invention, apparatus for filling a container with fluid at a predetermined pressure and for sealing together metal parts of the container capable of being pressure welded, comprises an enclosed chamber formed by a piston and cylinder which co-operate to produce the pressure weld, welding pressure being applied across the piston and cylinder and fluid being supplied to the chamber so as to fill the container to the required pressure. Preferably, cold pressure welding is used. The fluid pressure may be obtained by external means or the pressure may be obtained simply by compression in the cylinder.

The cylinder may house or be formed with one cold pressure welding tool and the piston be formed with, carry or serve to operate co-operating cold pressure welding tool.

The wall of the cylinder may be bored for the passage of fluid.

If two circular aluminium discs are to be hermetically sealed around their edges, the co-operating tools would be circular tools to engage the discs adjacent their edges. The tools may be upstanding shoulders on the piston and cylinder.

In carrying the invention into effect, according to one example of construction, apparatus for filling with air and sealing air pressure cells for oil-filled electric cables, the cells being made of circular discs of commercial purity aluminium, comprises a mild steel base of circular section which is bored to form a cylinder. The bore of the cylinder is such that the discs just fit loosely therein and, at the bottom of the cylinder, there is provided an upstanding shoulder running round the bottom in the form of an annulus and spaced a short distance away from the side of the bore.

The top of the shoulder, which is turned out from the metal of the base, is flat and forms one of a pair of cold pressure welding tools. Actually, the shoulder is formed on the inner edge of a step around the bottom of the bore and, in order that air may be supplied to the cylinder, an air passage is drilled through the base parallel to the bottom of the bore and has one branch ending radially outwards of the shoulder and another radially inwards of the step. A tube carrying a pressure gauge is sweated or threaded into the air passage and air under pressure is arranged to be supplied to the tube, suitable taps or cocks being provided.

A piston which moves in the cylinder with

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a good fit is also of mild steel and the bottom of the piston is formed with a step and shoulder complementary to the step and shoulder on the bottom of the cylinder bore. The shoulder on the piston forms the other tool of the pair of cold pressure welding tools and an air passage connects a point radially outwards of the shoulder on the piston to a point radially inwards of the step on the piston.

The piston is unprovided with a piston rod and the height of the bore of the cylinder and the axial length of the piston are so arranged that when the top of the piston is flush with the top of the cylinder, the correct percentage reduction at the weld is obtained. To obtain the necessary welding pressure the piston and cylinder are placed between the platens of a press and the piston forced in to effect welding. Alternatively, suitable stops may be provided and the piston may be operated through a piston rod coupled or forming part of a press.

The discs to be hermetically sealed together have raised edges so that when placed correctly relative to one another the main parts of the discs are spaced apart to form a container for air and a pair of discs, after rotary scratch brush clearing of the surfaces to be welded together, are placed in the cylinder upon the lower welding tool.

To effect the weld, the piston is then placed in the cylinder, air is pumped in to the required pressure, and the piston forced down to weld the edges of the discs together. The air is sealed in the pressure cell so formed at the required pressure and, on releasing the pressure from the press on the piston and cylinder, the air pressure aids the lifting of the piston from the cylinder.

Dated the 3rd day of November, 1948.

For the Applicants,
F. S. PEACHEY,
Chartered Patent Agent.

PROVISIONAL SPECIFICATION.
No. 2108, A.D. 1949.

Improvements in or relating to Pressure Welding Apparatus.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, and ANTHONY BAGNOLD SOWTER, of Research Laboratories of The General Electric Company Limited, Wembley, Middlesex, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to pressure welding apparatus.

In the Provisional Specification accompanying co-pending Patent Application No. 28586/48, there is disclosed apparatus for filling a container with fluid at a predetermined pressure and for sealing together metal parts of the container capable of being pressure welded, comprising an enclosed chamber formed by a piston and cylinder which are arranged to co-operate to produce the pressure weld, welding pressure being arranged to be applied across the piston and cylinder and fluid being arranged to be supplied to the chamber so as to fill the container to the required pressure.

In an example described in the said specification, apparatus for filling with air and sealing air pressure cells for use with oil-filled electric cables uses cold pressure welding and the air filling is at a pressure above normal atmospheric pressure.

Now, according to the present invention, the apparatus may be used to seal containers where the gas pressure inside is below normal atmospheric pressure. Thus, a container may be partially or substantially completely evacuated of air and, if evacuated, it may be filled to any required pressure with another gas or gases.

The apparatus may be conveniently connected to a vacuum pump for evacuating the air from the enclosed chamber and, if some gas, other than air, is to be the filling of the container, a suitable supply pipe controlled by a valve will be included in the apparatus.

The apparatus may be used for evacuating and sealing ionisation chambers of the condenser manometer cell type comprising two shallow dishes of aluminium cold welded together around their edges. Such cells have an insulated inner electrode with a lead passing through the wall of a cell, the dishes forming the other electrode, and, in evacuating and sealing a cell, the two dishes would be placed in the enclosed chamber of the apparatus and the piston and cylinder closed down onto a stop with the two dishes separated slightly. A rubber gasket, compressed between the piston and cylinder may seal the chamber which may then be evacuated. When evacuated, the stop may be removed and pressure applied across the piston and cylinder further to compress the gasket and effect the cold welding of the dishes together.

The invention may also be applied to the evacuating and sealing of radio valves having metal parts, capable of being cold welded, forming part of a valve envelope. Thus, two radial flanges on tubular copper

parts of a radio valve [illegible] be cold welded together in apparatus of the nature described above. In order to prevent distortion or misplacement of the tubular parts, those portions of the flanges which are welded together may be connected to the tubular parts by portions capable of flexing. Thus, a radial flange may have one thickness giving the required strength where joined to a tubular part and a smaller thickness extending over the major part of its area away from the joint with the tubular part.

The pressure welding apparatus may include electrical connections for allowing processing of a valve when a place therein and the usual baking and eddy current heating of the valve parts for out-gassing may take place whilst the valve is in the apparatus. Thus, the apparatus may include, in the enclosed chamber, a resistance heating element and an E.C.H. coil.

In applying the invention to the manufacture of cathode ray tubes comprising a flat glass-screen of high quality plate glass sealed to a funnel-shaped metal body supporting the electrode system, the body may be made in two parts and of metal, such as copper, capable of being cold welded. Radial flanges on these two parts would be welded together in apparatus of the nature described above. Possibly, a copper annulus generally of angle section may have a plate glass disc sealed into it and the radial flange of the annulus may be welded to a corresponding flange on a funnel-shaped body part.

Dated the 26th day of January, 1949.

For the Applicants,
F. S. PEACHEY,
Chartered Patent Agent.

COMPLETE SPECIFICATION.

Improvements in or relating to Pressure Welding Apparatus.

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, and ANTHONY BAGNOLD SOWTER, of Research Laboratories of The General Electric Company Limited, Wembley, Middlesex, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described an ascertained in and by the following statement:—

This invention relates to pressure welding apparatus.

In connection with fluid-filled, for example oil-filled, electric cables, it is well known that means should be provided for compensating for expansion and contraction of the oil-filling caused by changes in temperature. For this purpose, flexible and expansible gas-filled containers are used and one known form of gas-filled container or cell comprises two flanged circular sheet metal discs hermetically sealed together by brazing or soldering around their meeting flanges. To make such cells, a filling tube must be used and, after filling with gas such as air to the correct pressure, this tube is sealed off.

This process is somewhat lengthy and unsatisfactory in that leaks may easily develop and one object of the present invention is the provision of a pressure welding apparatus by which such gas-filled cells can be made in a simple and convenient manner.

According to the present invention apparatus for sealing together metal parts of the container, which parts are capable of being pressure welded, and for either filling the container with, for example, a gas or gases at a required pressure or evacuating the container comprises an enclosed chamber formed by a piston and cylinder which are arranged to co-operate to produce the pressure weld, welding pressure being arranged to be applied across the piston and cylinder after filling or evacuation of the chamber and container.

Preferably, cold pressure welding is used although some heat may be applied in certain cases in addition to pressure.

The pressure in the container may be obtained by external means or the pressure may be obtained simply by compression in the cylinder.

The cylinder may house or be formed with one cold pressure welding tool and the piston be formed with, carry or serve to operate a co-operating cold pressure welding tool.

The wall of the cylinder may be bored for the passage of fluid.

If two circular dished aluminium discs are to be hermetically sealed around their edges, the co-operating tools would be circular tools to engage the discs adjacent their edges. The tools may be upstanding shoulders on the head of the piston and the bottom of the cylinder.

Several arrangements of apparatus in accordance with the present invention will now be described by way of example with reference to the accompanying drawings in which Figure 1 shows, somewhat diagrammatically, a central sectional view of one form of apparatus for filling with air and

sealing air pressure cells for oil-filled cables, Figure 2 shows a central sectional view of a modified form of apparatus for evacuating and sealing ionisation chambers of the condenser manometer cell type, and Figure 3 shows a detail of a radio valve. For simplicity, like parts in Figures 1 and 2 have been given the same reference numerals.

Referring now to Figure 1, the apparatus for filling with air and sealing air pressure cells for oil-filled electric cables, the cells being made of circular discs of commercial purity aluminium, comprises a mild steel base 1 of circular section which is bored axially to form a cylinder. The bore of the cylinder is such that the discs 2 of the cell just fit loosely therein and, at the bottom of the cylinder, there is provided an upstanding shoulder 3 running round the bottom in the form of an annulus and spaced a short distance away from the side of the bore.

The top of the shoulder 3, which is turned out from the metal of the base 1, is flat, that is, the top of the shoulder 3 forms a flat annulus in a plane perpendicular to the axis of the bore, and the shoulder 3 forms one of a pair of ring-shaped cold pressure welding tools. Actually, the shoulder 3 is formed on the inner edge of a step 4 around the bottom of the bore and, in order that air may be supplied to the cylinder, an air passage 5 is drilled through the base 1 parallel to the bottom of the bore and has one branch 6 ending radially inwards of the shoulder 3 and step 4 and another branch 7 ending radially outwards of the shoulder 3. A tube 8 carrying a pressure gauge 9 is threaded into the air passage 5 and air under pressure is arranged to be supplied to the tube 8, suitable taps or cocks (not shown) being provided.

A piston 10 which moves in the cylinder with a good fit is also of mild steel and the bottom of the piston is formed with a step 11 and shoulder 12 complementary to the step 4 and shoulder 3 on the bottom of the cylinder bore. The shoulder 12 on the piston 10 forms the other tool of the pair of cold pressure welding tools and an air passage 13 connects a point radially outwards of the shoulder 12 on the piston 10 to a point radially inwards of the step 11 on the piston 10.

The piston 10 is unprovided with a piston rod and the height of the bore of the cylinder formed by the base 1 and the axial length of the piston 10 are so arranged that when the top of the piston is flush with the top of the cylinder, the correct percentage reduction of about 70% in the total thickness of the two layers of aluminium at the weld is obtained. To obtain the necessary welding pressure the piston and cylinder base 1 are placed between the platens 14 of a press and the piston 10 forced in to effect welding. Alternatively, suitable stops may be provided and the piston may be operated through a piston rod coupled or forming part of a press.

The discs 2 to be hermetically sealed together are slightly dished and have flat peripheral edges 15 so that when placed correctly relative to one another the main parts of the discs 2 are spaced apart to form a container for air and the pair of discs 2, after rotary scratch brush cleaning of the facing surfaces to be welded together, are placed in the cylinder base 1 upon the lower welding tool, that is, the shoulder 3.

To effect the weld, the piston 10 is then placed in the cylinder base 1, air is pumped in via the tube 8 to the required pressure, and the piston 10 forced down by the press platens 14 to weld the edges 15 of the discs 2 together. The air is sealed in the pressure cell so formed at the required pressure and, on releasing the pressure from the press on the piston 10 and cylinder base 1, the air pressure in the space between the piston 10 and base 1 aids the lifting of the piston 10 from the cylinder.

As mentioned above, the percentage reduction in thickness at the welded joint will be about 70% of the combined thickness of the two edges 15. The radial width of the flat tops of the shoulders 3 and 12 will be chosen suitably at a value comparable with the gauge of the discs 2 but, in the figure, for clarity, the shoulders have been shown with an increased radial width.

Instead of using flat topped tools, tools may be used which are slightly radiused but, in any case, the radius should be large compared with the gauge of the material welded. Further, the welding tools need not be formed in one with the piston 10 and cylinder base 1; if desired, the tools may simply be carried by or attached to these parts.

In a case where it is desired to make an evacuated container with a ring seal or a similar container with gas other than air, then the tube 8 would be connected to a vacuum pump and, if need be, by way of a two-way cock, to a supply of the required gas.

A somewhat modified apparatus for evacuating and sealing ionisation chambers of the condenser manometer cell type comprising two shallow dishes of aluminium cold welded together around their edges is shown in Figure 2 of the drawings. Such cells have an insulated inner electrode with a lead passing by way of an insulated terminal through the wall of a cell, the dishes forming the other electrode. Referring now to Figure 2, the piston and cylinder are inverted as regards their positions compared with the arrangement shown in Figure 1

and, in the modified construction, the piston 10 is bolted to a square base plate 15 of mild steel. The piston 10 sits flat on the plate 15 and, around the bottom edge of the piston, the plate is provided with a groove 16 in which is located an oil resisting rubber ring 17 stretched into position. The purpose of this ring 17 will be apparent from the following description. The top of the piston 10 is provided with a step 11, recessed at 21 to provide a clearance for the terminal of the cell, and with a welding shoulder 12. A passage 13 connects the spaces inwardly and outwardly of the shoulder 12.

The cylinder is formed by a tubular part 18 having a cap 19 closing the top thereof, the cap 19 being bolted in position and jointing compound being used at the joint 20 between the cap 19 and part 18, and, as before, the cylinder is provided with a step 4 and a welding shoulder 3. A passage 5 leading to passages 6 and 7 inwardly and outwardly of the shoulder 3 are provided in the cap 19.

In evacuating and sealing a cell, the two dishes, whose surfaces to be welded would be cleaned as by scratch-brushing, would be placed one on the other on the piston 10 with the terminal of the cell in the recess 21. The piston and cylinder would then be moved together so that the part 18 touches and compresses slightly the ring 17 but is prevented from fully closing by removable stops (not shown). The dishes are thus held in an air-tight chamber but no pressure is applied across the meeting surfaces of the two dishes so that air may escape quite freely from the space between them. Then, air is pumped out of the chamber by way of the passage 5 in the cap 19 until the required vacuum is obtained, the stops are removed and the cylinder allowed to come down fully under the force of a press to cold weld the dishes together. Meeting of the bottom of the part 18 with the face of the plate 15 prevents over-penetration of the shoulders 3 and 12 into the metal of the dishes and thereby controls the percentage reduction in thickness at the ring weld.

The invention may also be applied to the evacuating and sealing of radio valves having metal parts, capable of being cold pressure welded, forming part of a valve envelope. Thus, two radial flanges on tubular copper parts of a radio valve may be cold pressure welded together in apparatus generally of the nature described above with reference to Figure 1 or Figure 2. In order to prevent distortion or misplacement of the tubular parts, those portions of the flanges which are welded together may be connected to the tubular parts by portions capable of flexing. Thus, as shown in Figure 3, a radial flange 22 may have one thickness giving the required strength at the point 23 where it is joined to a tubular part 24 and a smaller thickness extending over the major part 25 of its area way from the joint with the tubular part 24.

The pressure welding apparatus may include electrical connections for allowing processing of a valve when in place therein and the usual baking and eddy current heating of the valve parts for out-gassing may take place whilst the valve is in the apparatus. Thus, the apparatus may include, in the enclosed chamber, a resistance heating element and an E.C.H. coil.

In applying the invention to the manufacture of cathode ray tubes comprising a flat glass screen of high quality plate glass sealed to a funnel-shaped metal body supporting the electrode system, the body may be made in two parts and of metal, such as copper, capable of being cold pressure welded. Radial flanges on these two parts would be welded together in apparatus of the nature described above. Possibly, a copper annulus generally of angle section may have a plate glass disc sealed into it and the radial flange of the annulus may be welded to a corresponding flange on a funnel-shaped body part.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:

1. Apparatus for sealing together metal parts of a container, which parts are capable of being pressure welded, and for either filling the container with, for example, a gas or gases at a required pressure or evacuating the container, comprising an enclosed chamber formed by a piston and cylinder which are arranged to co-operate to produce the pressure weld, welding pressure being adapted to be applied across the piston and cylinder after filling or evacuation of the chamber and container.

2. Apparatus as claimed in Claim 1, wherein the piston and cylinder are arranged to effect cold pressure welding together of the metal parts.

3. Cold pressure welding apparatus for making a seal between co-operating metal parts of a container, which parts are capable of being cold pressure welded, and for permitting filling or evacuation of the container, comprising a cylinder, a first cold pressure welding tool associated with the cylinder, a piston, and a second cold pressure welding tool associated with the piston, the piston and cylinder defining an enclosing chamber for the container in which chamber it is adapted to be filled or evacuated and the said metal parts cold pressure welded together by the first and second cold pressure welding tools.

4. Cold pressure welding apparatus as claimed in Claim 3, wherein the pressure of a gas filling, for example air filling, in the container is arranged to be obtained simply by compression in the cylinder caused by the piston.

5. Cold pressure welding apparatus as claimed in Claim 3, wherein the wall of the cylinder is bored for the passage of fluid to permit filling or evacuation of the container.

6. Cold pressure welding apparatus for hermetically sealing together around their edges two dished discs of metal capable of being cold pressure welded and for filling or evacuating the container formed by the discs, comprising a piston, a first ring-shaped cold pressure welding tool associated with the piston, a cylinder, and a second ring-shaped cold pressure welding tool associated with the cylinder, the piston and cylinder defining an enclosing chamber in which the container is arranged to be first filled or evacuated and then sealed by the welding tools which engage the discs at or adjacent their edges.

7. Cold pressure welding apparatus as claimed in Claim 6, wherein the said welding tools are formed by upstanding shoulders on the head of the piston and the bottom of the cylinder.

8. Cold pressure welding apparatus as claimed in Claim 7, wherein the welding surfaces of the upstanding shoulders are flat.

9. A container made by apparatus in accordance with any preceding claim.

10. Cold pressure welding apparatus as claimed in Claim 3 and for use in the manufacture of radio valves, wherein the apparatus includes means for allowing processing of the valve in the enclosed chamber, such as baking and out-gassing.

11. Cold pressure welding apparatus substantially as hereinbefore described with reference to Figure 1 or Figure 2 of the accompanying drawings.

Dated the 3rd day of November, 1949.

For the Applicants,
F. S. PEACHEY,
Chartered Patent Agent.

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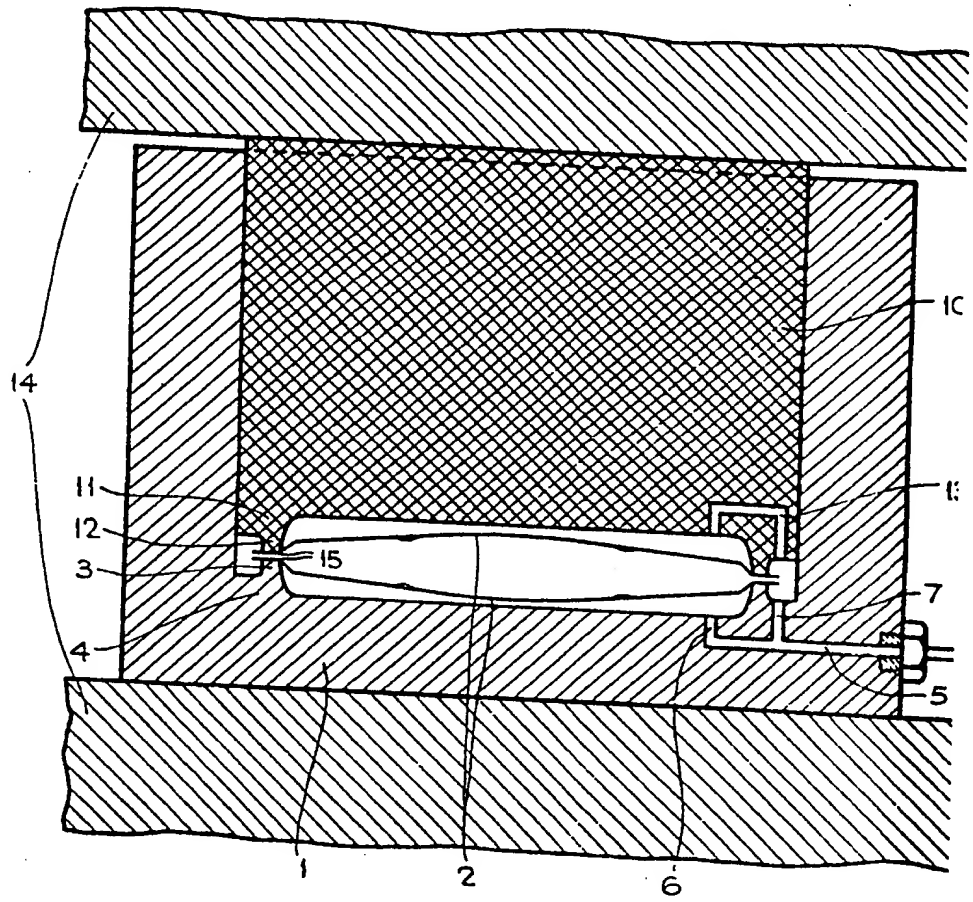

FIG.1

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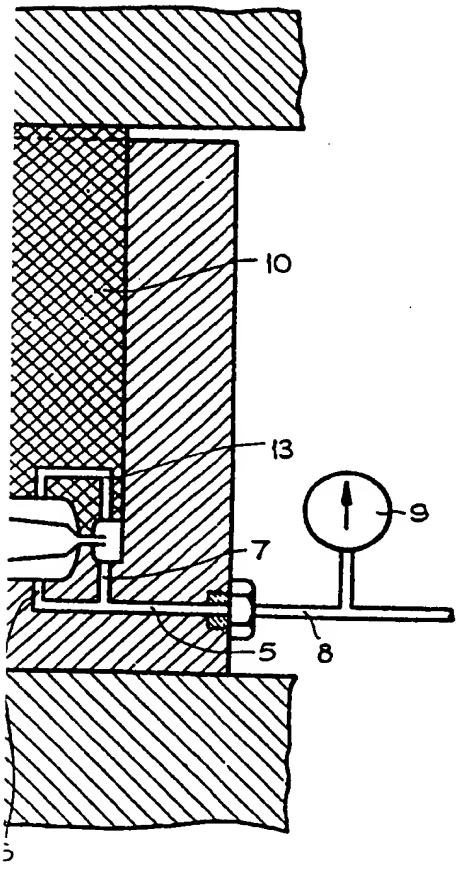

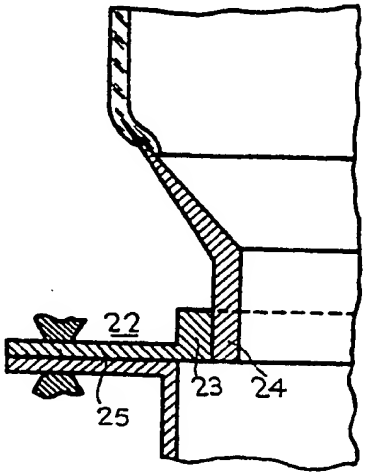

FIG. 3

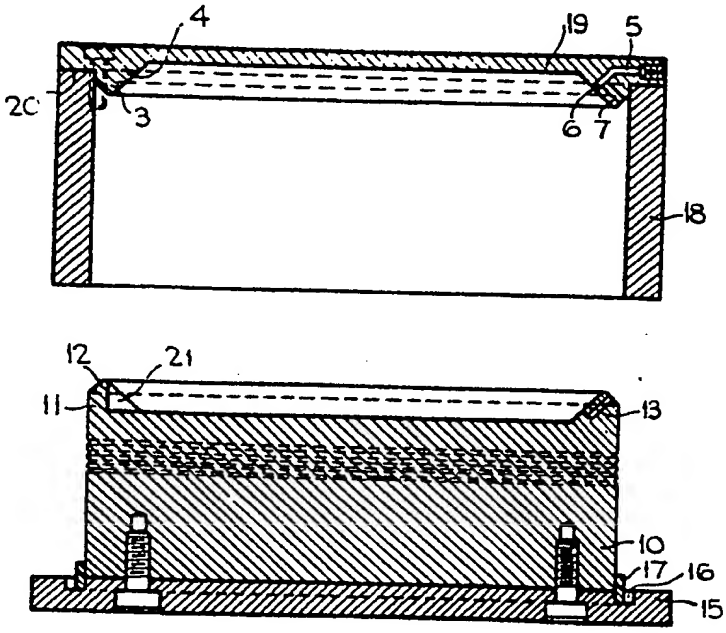

FIG. 2

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654,214 COMPLETE SPECIFICATION

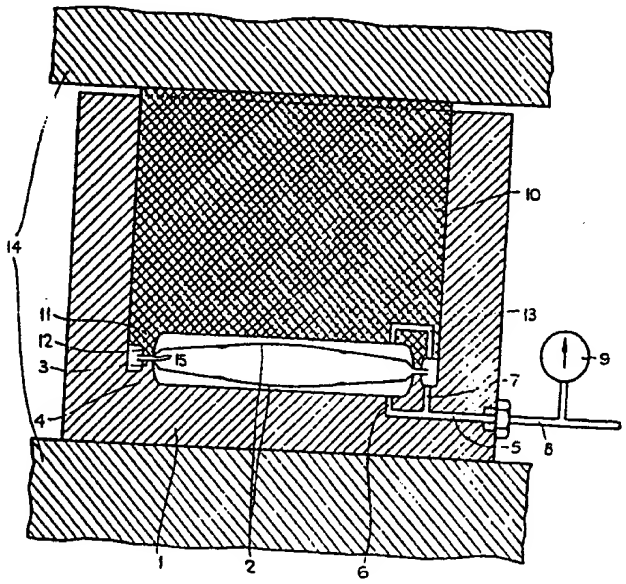

FIG. 1

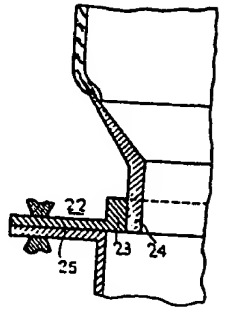

FIG. 3

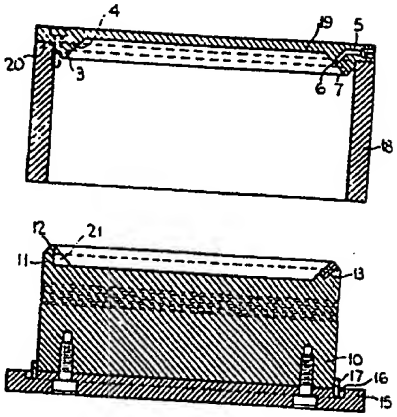

FIG. 2

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H.M.S.O. (M.F.P.)